The Full Story of Runs

Jun Kyung Auh and Hayong Yun

Georgetown and MSU

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Motivation

- Secured lending is huge
  - Home mortgages ($9.8 tr.)
  - Almost all bank loans
  - Repurchase agreement ($5-$10 tr.)

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- Secured lending is huge
  - Home mortgages ($9.8 tr.)
  - Almost all bank loans
  - Repurchase agreement ($5-$10 tr.)
- A secured lending contract has price and non-price terms
  1. Spread (interest rate)
  2. Loan duration
  3. Over-collateralization (margin or haircut)

Question

- Upon a negative signal for the borrower, non-price terms dynamically changes, triggering "run"
  - Run on margin (e.g., Martin et. al. (2014))/ Run on maturity (e.g.,Brunnermeier and Oehmke (2013))
  - How do lenders collectively behave before triggering run?
  - If there is a significant variation across lenders' behavior, what drives the variation?
  - Important question to understand run dynamics

Prior Literature/ Contribution

- Most prior research focus on the aggregate post-run behaviors
  1. General run: Diamond and Dybvig, (1983). Acharya, Gale, and Yorulmazer (2011), Bebchuk and Goldstein (2011), Hertzberg, Liberti, and Paravasini (2010), Iyer and Puri (2012), Schmidt, Timmerman, and Wermers (2016)
  2. Dynamic theory: Martin et. al. (2014), Gorton and Ordonez (2014), Brunnermeier and Oehmke (2013), Brunnermeier and Pedersen (2009), Acharya et.al. (2011), He and Xiong (2012).
  3. Empirical documentation: Copeland, et.al. (2014), Gorton and Metrick (2012), Krishnamurthy et.al. (2014).
- However, due to lack of micro data on loans with high-frequency term change, little evidence is documented about ex-ante behavior at the lender or loan level

Our approach

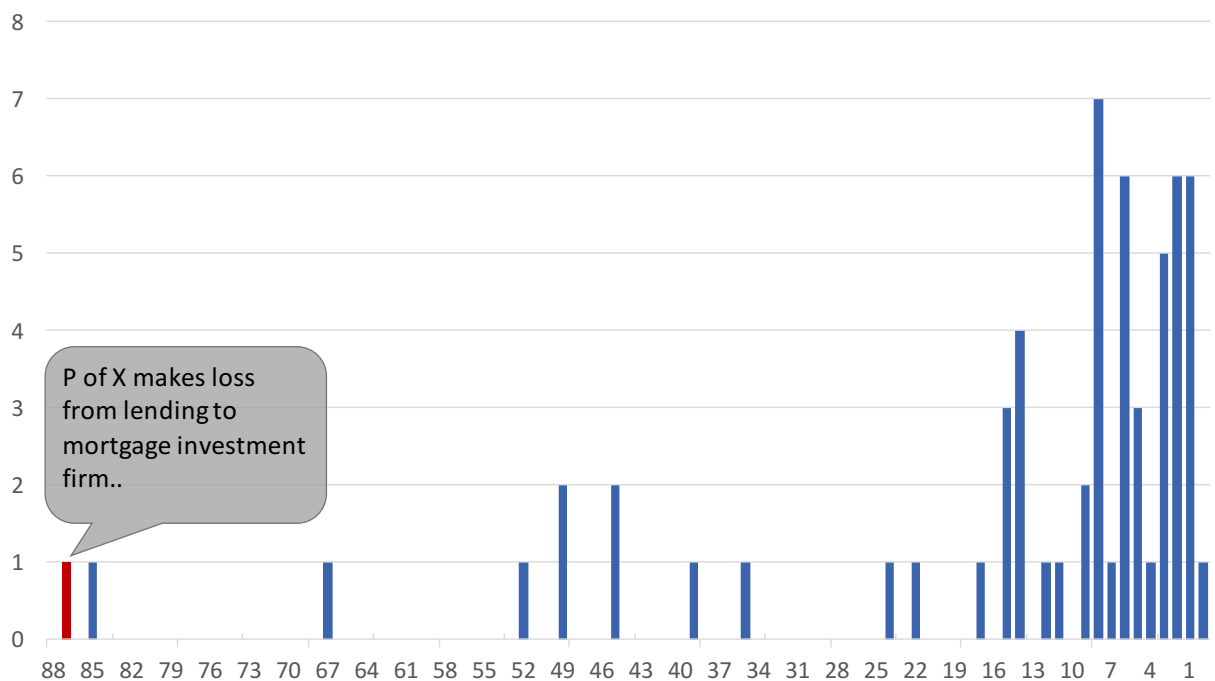
- We use bilateral repo contracts in a particular set up:
  - The borrower (hedge fund; Fund X) eventually defaults
  - Loans are contracted with 16 different lenders (dealer banks) without the ability to see others' terms
  - Loans are contracted against identifiable collateral $\rightarrow$ Can identify a sequence of loans to hold an asset position (rolled-over loans)
  - Loan terms change at roll over points
  - We can observe entire lending history with the borrower (lender-by-lender)
- We focus on dynamic lender behavior during this extreme period ($d = -88$ to $d = 0$)

Repo primer

- What is Repo?
  - A dominant funding channel in financial market
  - Secured lending contracts collateralized by a financial asset
  - The borrower can construct leveraged position on this asset
- Example:
  - Borrower wants to buy an asset with MV = \$100
  - Borrower borrows \$90 and put \$10 of own capital to buy this asset (10x leverage)
  - Simultaneously pledges this as collateral and promises to buy back at \$90.45 after 1 mo.
  - Repo rate (interest rate) = 50bps per mo. or 6% per annum (\$90.45/\$90 for 1 mo)
  - Haircut (margin) = 10% (\$100/\$90-1)

Background

- At $d = 0$, Fund X defaulted
  - Fund X invests in mostly structured finance asset (MBS, ABS, CDO..) using repo financing from a group of lenders
  - Negative news starts arriving from $d = -88$



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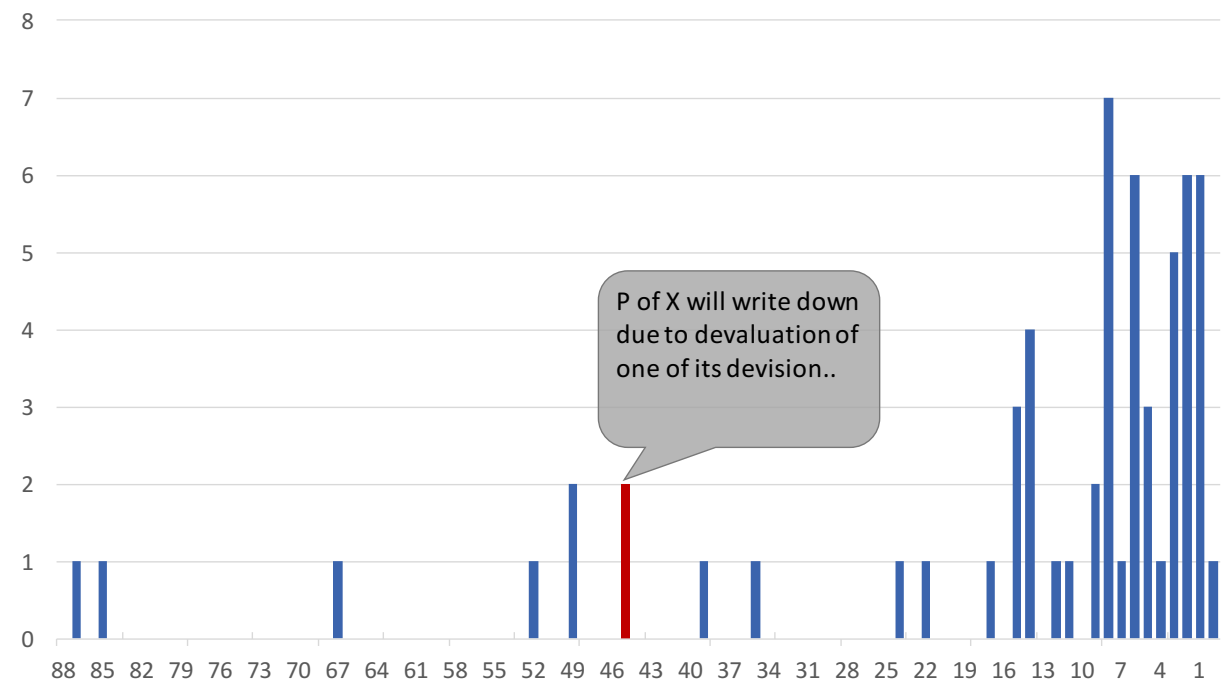

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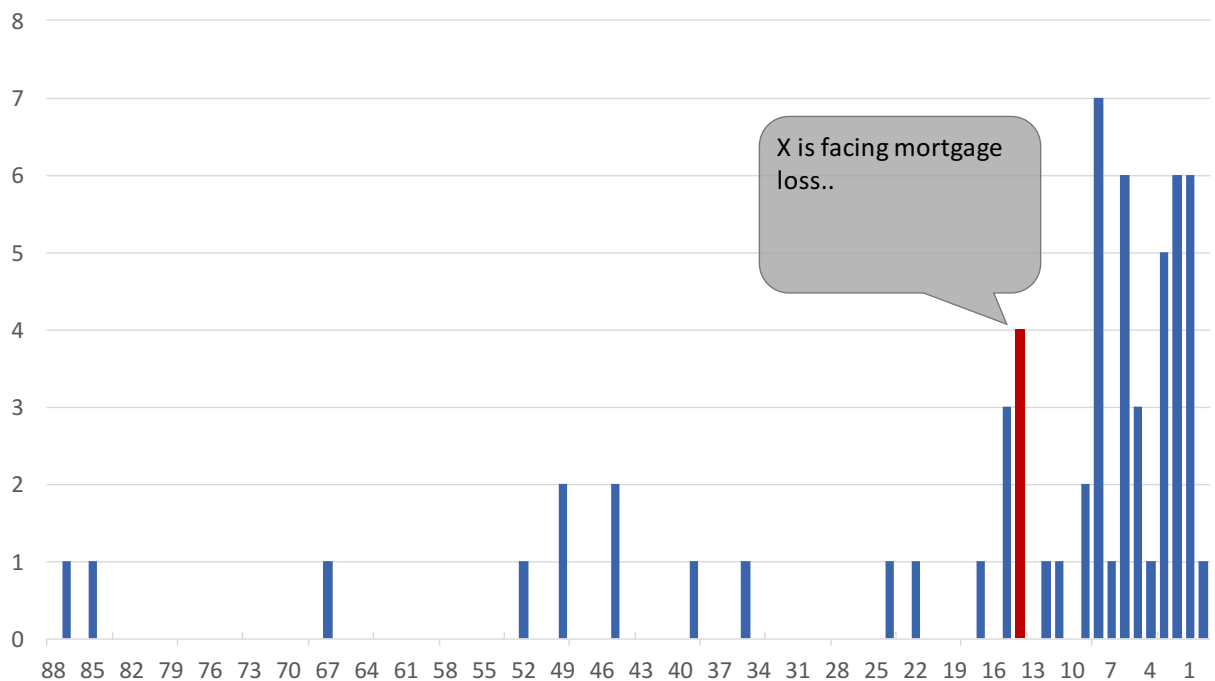

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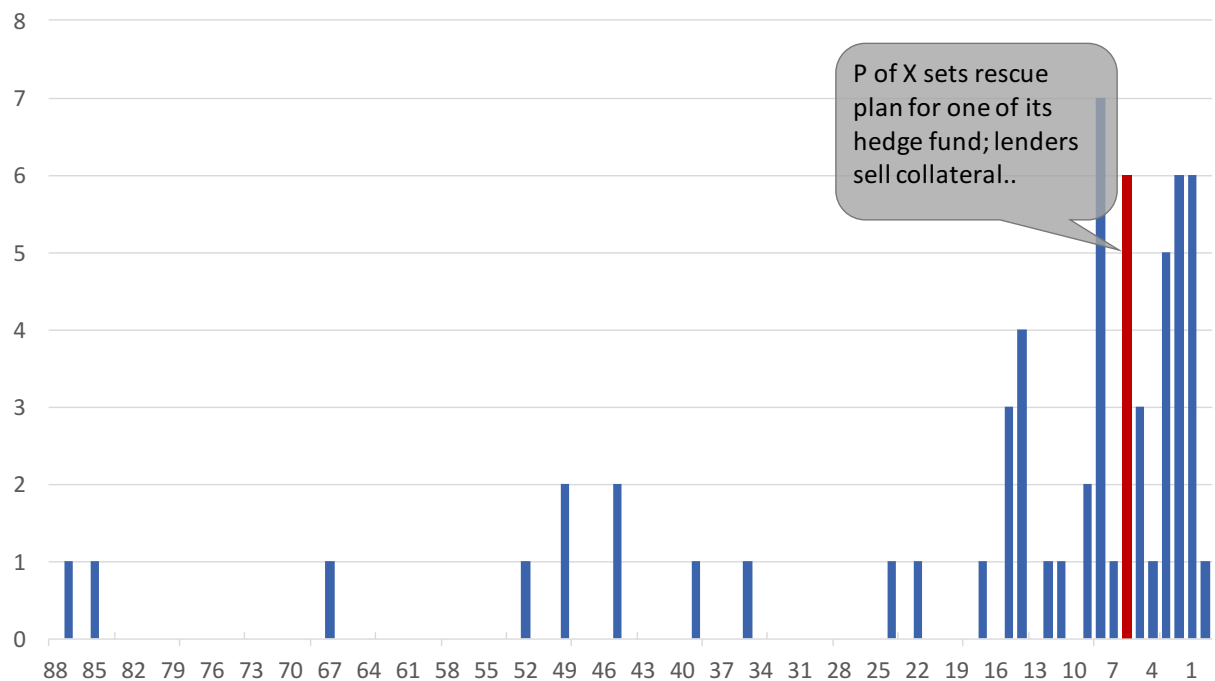

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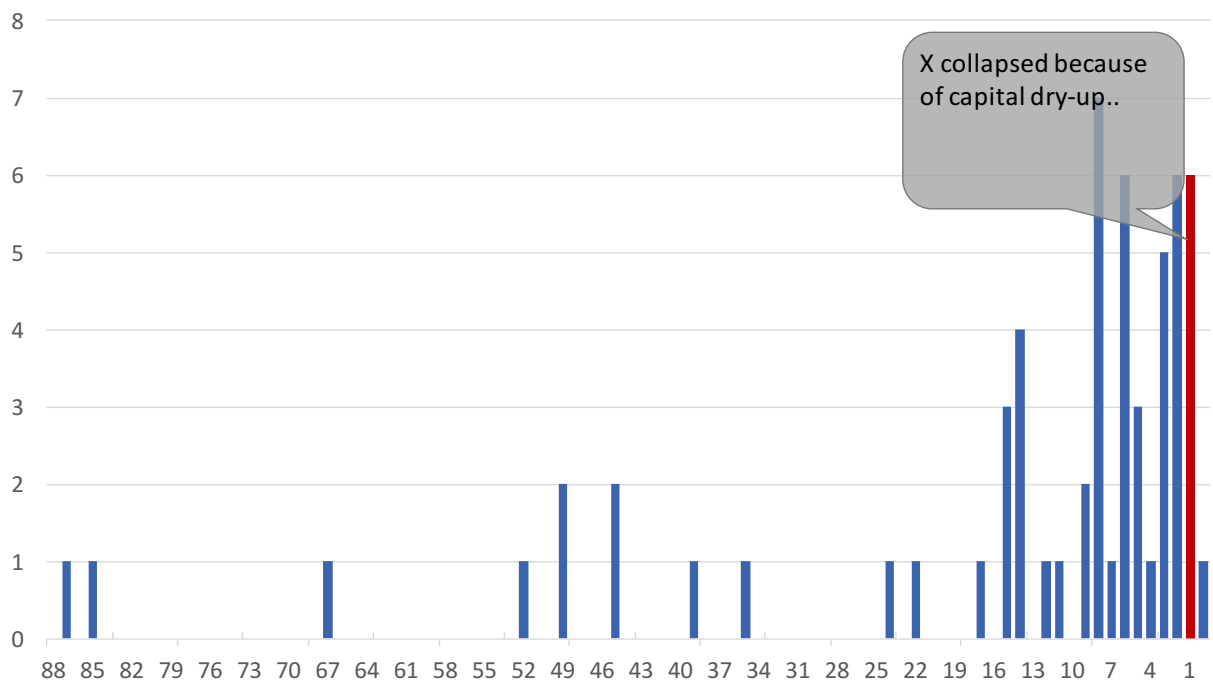
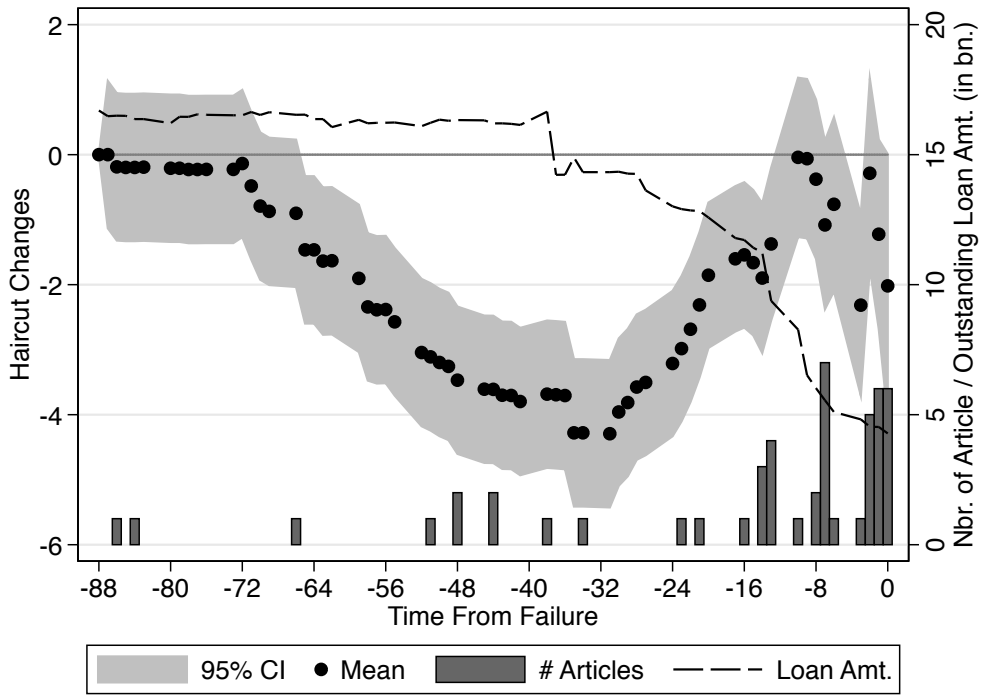


Dynamics of run

- Starting from $d = -88$, we track, loan-by-loan, the margin changes during this period at roll-over points



* Shows clear, non-monotonic credit contraction pattern, consistent with the model prediction! ▸ More

Data

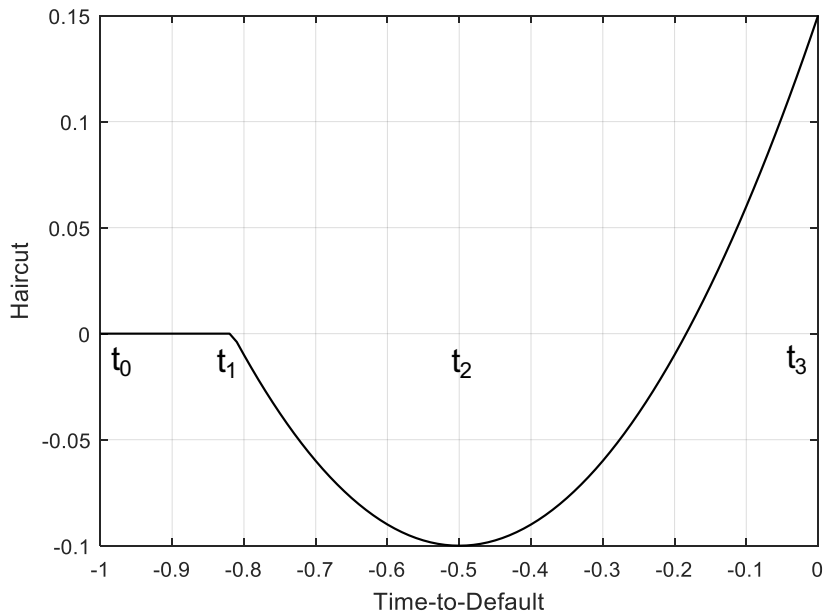
- Raw data contains 3 years of entire repo book of Fund X (one of top 5 largest funds by AUM by strategy classification)
  - Raw data: 290,606 loan observation, 16,807 unique repo contracts, 54 lenders, 1,590 unique collateral
  - Our data of interest: 16 lenders, 584 roll-over points
  - Asset class distribution of collateral in our sample: CDO (31%), MBS(13%), Other SF (17%), Corporate bond (13%), Treasury (2%)

Timing of action

- We specify action timing:
  1. t_0 as $d = -88$, the first day of negative news
  2. t_1 as the start date of the margin reduction (more relaxed credit supply)
  3. t_2 as the start date of credit contraction (run)
  4. t_3 as $d = 0$

Timing of action

- Corresponding to the observed haircut dynamics



- We define...
  1. Initial Response: $t_1 - t_0$
  2. Lender Patience: $t_2 - t_1$

Empirical Design

- We use 4 different specifications to explain our 2 variables of interests
- For lender j, we estimate:
  1. OLS: $\Delta t_j = \alpha + \beta \cdot x_j + \varepsilon_j$
  2. Cox hazard model: $h(t|x_j) = h_0(t)\, exp(x_j \beta_x)$
  3. Weibull: $h(t|x_j) = p t^{p-1} exp(x_j \beta_x)$
  4. AFT: $\log(t_j) = x_j \beta_x + \beta_0 + u_j$
- where t is either Initial Response or Lender Patience, x is a vector of explanatory variables

Lender-Level Analysis [1/2]

- Initial Response $(t_1 - t_0)$

Dependent Variables	Initial Response $(t_1 - t_0)$			
	(I)	(II)	(III)	(IV)
Log(Principal)	-12.79***	1.34***	0.96***	-0.27***
	[1.94]	[0.28]	[0.148]	[0.048]
Log(Relationship)	-19.042***	1.27***	1.18***	-0.33***
	[5.94]	[0.38]	[0.23]	[0.04]
Observations	16	16	16	16

* Lenders with larger vested interest step in quicker: $1\sigma \rightarrow$14 days [1]
* Lenders with longer lending relationship step in quicker: $1\sigma \rightarrow$7 days [2]

[1] 42 days $\times$ [1-($e^{1.5 \times -0.27}$))]
[2] 42 days $\times$ [1-($e^{0.5 \times -0.33}$))]

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Lender-Level Analysis [2/2]

- Lender Patience $(t_2 - t_1)$

Dependent Variables	Lender Patience $(t_2 - t_1)$			
	(V)	(VI)	(VII)	(VIII)
Log(Principal)	8.68***	-0.60***	-1.21***	0.75***
	[2.13]	[0.14]	[0.34]	[0.196]
Log(Relationship)	14.05*	-0.98***	-2.52***	1.57***
	[6.51]	[0.27]	[0.56]	[0.12]
Observations	16	16	16	16

* Lenders with larger vested interest wait longer: $1\sigma \rightarrow$59 days [3]
* Lenders with longer lending relationship wait longer: $1\sigma \rightarrow$33 days [4]

[3] 28 days $\times$ [1-($e^{1.5\times0.75}$))]
[4] 28 days $\times$ [1-($e^{0.5\times1.57}$))]

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Loan-Level Analysis [1/2]

- Initial Response $(t_1 - t_0)$

Dependent Variables	Initial Response			
	(I)	(II)	(III)	(IV)
Log(Principal): Lender	-4.84***	0.13***	0.12***	-0.05***
	[0.83]	[0.02]	[0.02]	[0.01]
Log(Relationship)	-4.45	-0.12	0.15	-0.07
	[4.47]	[0.09]	[0.11]	[0.046]
Log(Principal): Loan	-4.39***	0.18***	0.15***	-0.06***
	[0.81]	[0.03]	[0.03]	[0.01]
Short-term	-5.17**	0.13	0.10	-0.04
	[2.30]	[0.09]	[0.10]	[0.04]
Observations	584	584	584	584

* Controlling for lender variation, terms of loans with larger capital interest loosen quicker: $1\sigma \rightarrow$4 days

Loan-Level Analysis [2/2]

- Lender Patience ($t_2 - t_1$)

Dependent Variables	Lender Patience			
	(V)	(VI)	(VII)	(VIII)
Log(Principal): Lender	4.62***	-0.20***	-0.35***	0.46***
	[0.77]	[0.03]	[0.07]	[0.08]
Log(Relationship)	5.03	-0.14	-0.18	0.23
	[4.08]	[0.18]	[0.27]	[0.35]
Log(Principal): Loan	1.82**	-0.05*	-0.09***	0.12***
	[0.74]	[0.03]	[0.03]	[0.04]
Short-term	6.45***	-0.41***	-0.24***	0.31***
	[2.11]	[0.09]	[0.08]	[0.11]
Observations	584	584	584	584

* Controlling for lender variation, terms of loans with larger capital interest are kept relaxed for a longer period: $1\sigma \rightarrow$9 days

Collateral-Level Analysis [1/2]

- Initial Response ($t_1 - t_0$) (AFT regression)

Dependent Variables	Initial Response ($t_1 - t_0$)		
	(I)	(II)	(III)
Structured Finance	-0.58***		
	[0.06]		
Corporate	-0.45***		
	[0.07]		
CDO		0.00	
		[0.05098]	
AAA			0.14**
			[0.06]
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B			-0.65***
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Observations	584	400	491

* Controlling for lender and loan variation, loans terms with less liquid collateral (structured finance, CDO, low-rated assets) loosen quicker: SF$\rightarrow$24 days, B vs. AAA$\rightarrow$34 days

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- Lender Patience ($t_2 - t_1$) (AFT regression)

Dependent Variables	Lender Patience ($t_2 - t_1$)		
	(IV)	(V)	(VI)
Structured Finance	3.92***		
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Corporate	3.41***		
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CDO		0.37***	
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AAA			-0.41***
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Conclusion

- What we found:
  1. Lenders' coordination behavior is not monotonic
  2. Lenders' with larger vested capital and longer relationship have stronger incentive to rescue their borrower
  3. Lenders' with less liquid collateral have larger interest in borrower's survival

Conclusion

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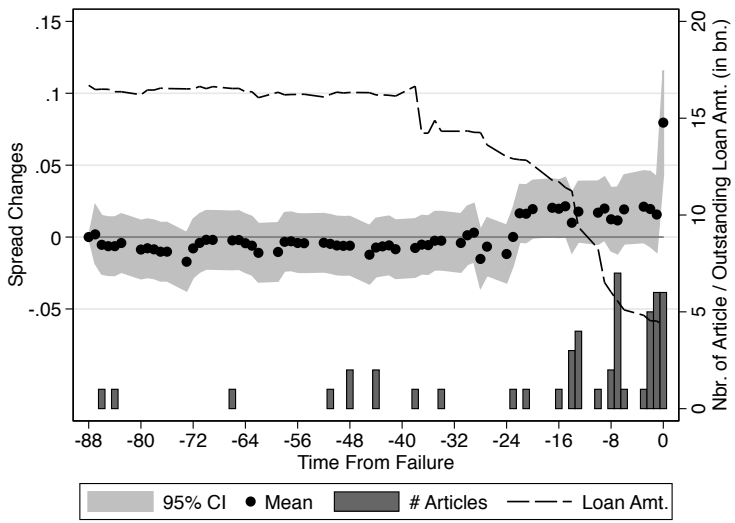
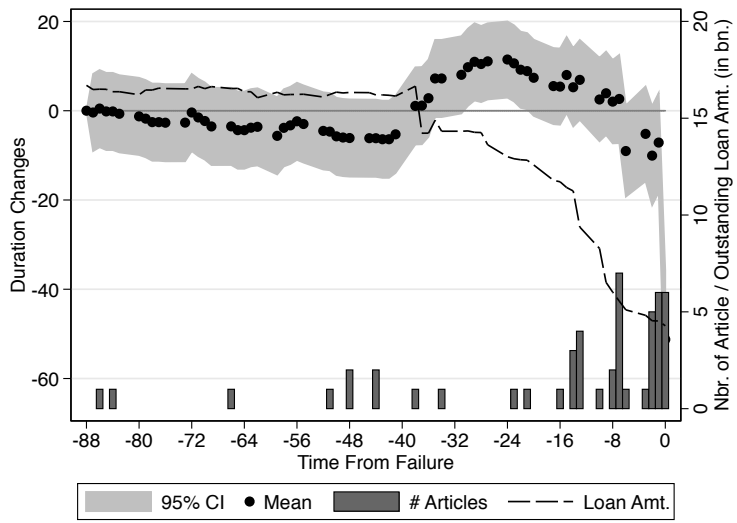
  1. Lenders' coordination behavior is not monotonic
  2. Lenders' with larger vested capital and longer relationship have stronger incentive to rescue their borrower
  3. Lenders' with less liquid collateral have larger interest in borrower's survival
- Implication
  1. Lenders' incentives depends on size of collateral and its separability
  2. Collateral as a miscoordination device ▸ Theory

Why not on other terms

- First of all, our paper is about credit supply ("run")
- Surprisingly, margin (credit supply) appears to be main dynamic risk management tool Go Back





Model setup

- Consider continuum of lenders and three dates (t_0, t_1, t_2)
  - Loan initiated at t_0 and possibly rolled over at t_1 to finance the borrower project whose payoff realizes at t_2
  - Lenders require collateral K_0 at t_0, and loan is contracted with interest rate R
  - Lenders receive private signal $x = \theta + \sigma_1 \varepsilon$ (θ measures fundamental) and make roll over decision
  - Completion of the project depends on lenders' coordination: if l_1 fraction of lenders roll over the project can survive; otherwise foreclosed and lenders liquidate collateral (Morris and Shin (2004))
  - Early liquidation is "inefficient": in expectation, payoff upon project completion is better ◂ Go Back

Benchmark case: Exogenous collateral requirement

- For a given K_0 set at t_0
  - **Proposition I:** $\exists$ a unique BNE in which all lenders with a signal larger than $x^\star$ roll over the loan and all others foreclose
  - $\rightarrow$ Critical state $\theta^\star$ that determine the likelihood of coordination success

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  - **Proposition I:** $\exists$ a unique BNE in which all lenders with a signal larger than $x^\star$ roll over the loan and all others foreclose
  - $\rightarrow$ Critical state $\theta^\star$ that determine the likelihood of coordination success
- Trade off: $\frac{\partial \theta^*(K_0)}{\partial K_0} \geq 0$ and $\frac{\partial \theta^*(R)}{\partial R} \leq 0$
  1. As a lender require larger collateral (K_0), it gives the lender better outside option (liquidation) $\rightarrow$ it increases $\theta^\star$ such that coordination failure becomes more likely
  2. As a lender is promised with higher compensation R, the lender has a larger incentive for project realization $\rightarrow$ it decreases $\theta^\star$ such that coordination success becomes more likely Go Back

Endogenous collateral requirement

- Lenders determine collateral level endogenously $\hat{K}_0$
  - **Proposition II:** Lenders require $\hat{K}_0 = 0$ or $\hat{K}_0 = 1$, and $\exists$ switching state $\bar{\theta}_0$ at which lenders are indifferent between these two

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  - **Proposition II:** Lenders require $\hat{K}_0 = 0$ or $\hat{K}_0 = 1$, and $\exists$ switching state $\bar{\theta}_0$ at which lenders are indifferent between these two
- Lenders determine collateral level endogenously $\hat{K}_0$
  - **Proposition III:** When this feedback channel is allowed, the critical state $(\hat{\theta}) \leq$ the case without the feedback effect $(\theta^{\star})$.
  - $\rightarrow$ Lenders may coordinate to lower the collateral to avoid the inefficient termination
  - Empirical implication: Collective behavior of dropping margin requirement is a consequence of lender coordination Go Back